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Edward Trimmer Esq
with the kind regards
the Author.

THE TEETH:

NOTES ON THEIR PATHOLOGY.

BY THE SAME AUTHOR,

DEFORMITIES of the MOUTH, Congenital and Acquired; their Mechanical Treatment. Illustrated by 51 Woodcuts and 8 Coloured Plates. Demy 8vo. Second Edition.

The MECHANISM of SPEECH. With Woodcuts and 26 Coloured Diagrams.

A MANUAL of DENTAL MECHANICS. With an Account of the Materials and Appliances used in Mechanical Dentistry. With numerous Engravings on Wood.

J. & A. CHURCHILL, NEW BURLINGTON STREET.
1872.

THE TEETH:

NOTES ON THEIR PATHOLOGY.

BY

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ROYAL COLLEGE OF SURGEONS OF
MEDICINA LITERIS

LONDON:
J. & A. CHURCHILL, NEW BURLINGTON STREET.

1872.

INTRODUCTION.

In the following pages I have reproduced, with some slight alterations and additions, a series of short articles that originally appeared in the British Journal of Dental Science, introducing, however, illustrations from Brück, with a view to render these Notes more worthy of the consideration with which they were received in their original form. They are now offered to the profession, rather as suggestive of fresh lines of thought, than as a finished contribution to Dental Literature.

81, Wimpole Street, Cavendish Square, W.
October, 1872.

EXPLANATION OF PLATE I.

Fig. 1. Dentinal Body from Pulp, showing radiating Continuous Canals.

Fig. 2. A Portion of the Crown Pulp of a Healthy Canine Tooth, with numerous Dentinal Bodies.

Fig. 3. Dentinal Bodies in the Pulp of a Milk Tooth.

Fig. 4. Dentinal Bodies, with apparent Belt.

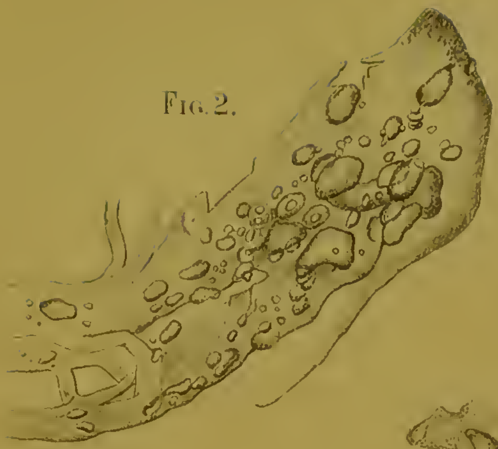
Fig. 5. Dentinal Bodies in the Pulp of a Dog's Tooth.

Fig. 6. Dentinal Bodies in the Pulp of a Horse's Tooth.

Fig. 7. Osteo-Dentinal Bodies, from the Fang Canal of a large Upper Molar.

Fig. 8. Agglomerated Dentinal Bodies.

FIG. 2.



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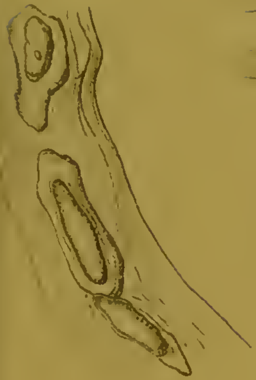

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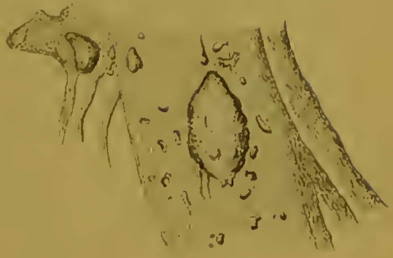

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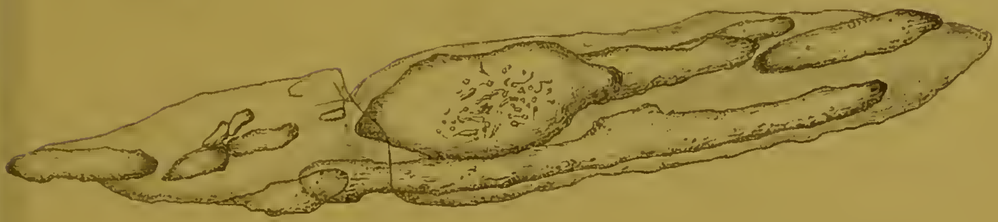

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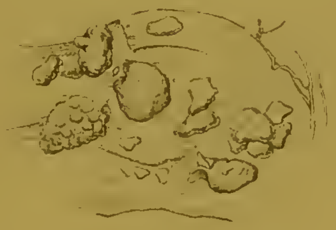

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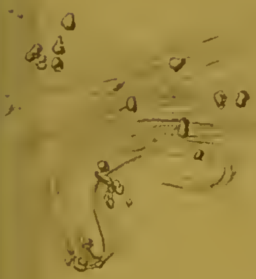

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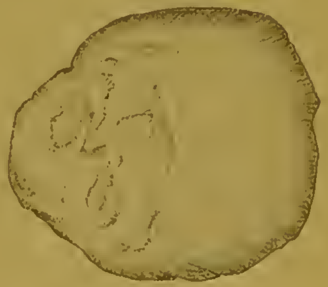

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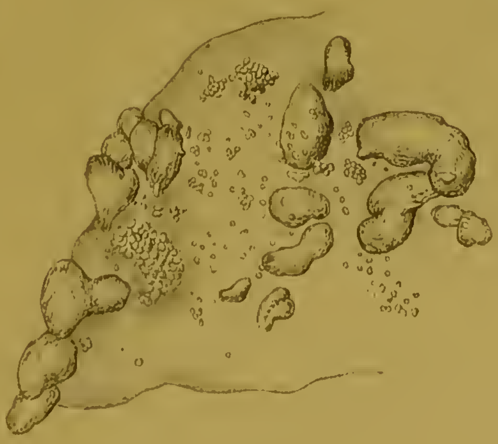

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E J FRANCIS, LITH TOOKS COURT, CHANCERY LANE

EXPLANATION OF PLATE II.

Fig. 1. Margin of a Dentinal Body.

Fig. 2. Chronic Pulpitis, with Enlarged Vessels (*b*) and Abscess (*a*).

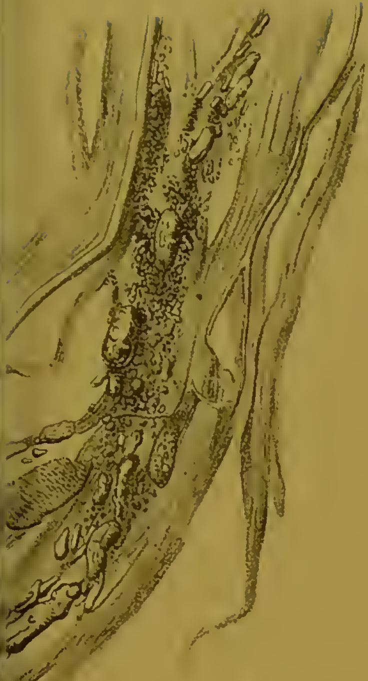
Fig. 3. A Mass of Dentinal Bodies in Pulp of Tooth, showing their various sizes.

Fig. 4. Microscopical Section of a Polypus of the Pulp.

Fig. 5. Freshly Extracted Pulp, showing Dentinal Bodies, (*a*) Small Body with numerous Dentinal Canals running through ; (*c*) A remarkably small Body, with numerous Canals ; (*b*) The smallest Dentinal Body (·00025 mm. length), with a Single Canal ; (*d*) Nerve Vessels Enlarged (800 diam.).

Fig. 6. Portion of same Pulp. *a*, *b*, Commencement of the smallest Dentinal Bodies ; *c*, *d*, Pale Protoplasmic continuations between the connective Tissue of the Pulp, around which the first Dentinal Bodies become developed.

Fig. 3



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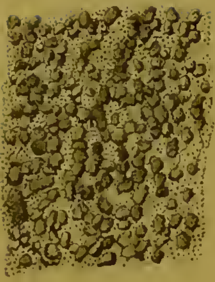

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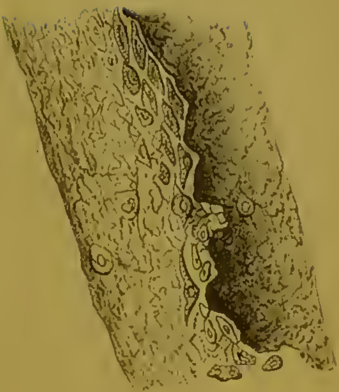


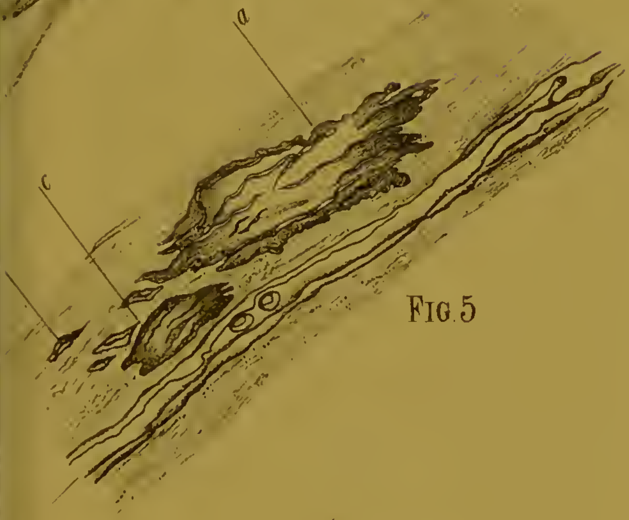
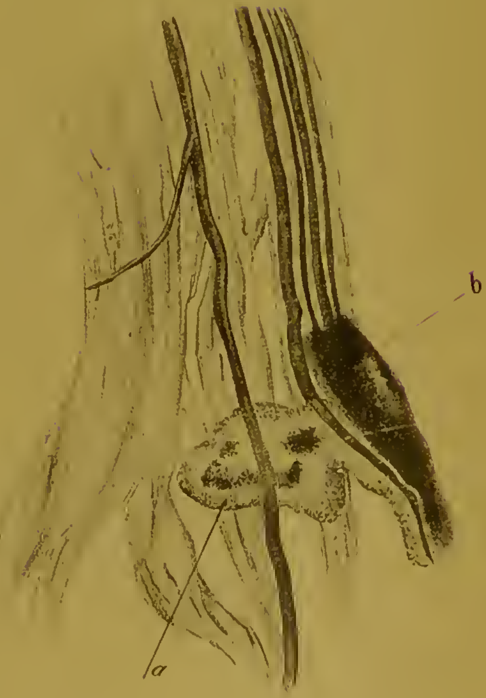


Fig. 5

Fig. 2.



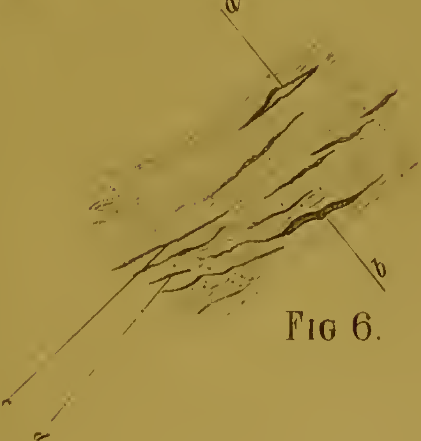


Fig 6.

E. J. FRANCIS LITH. TOOK'S COURT CHANCERY LANE

NOTES ON DENTAL PATHOLOGY.

SECONDARY DENTINE AND OSTEO-DENTINAL BODIES.

NUMEROUS cases brought before the Odontological Society, and several papers that have been recently printed, induce me to think that some short notes on the pathology of the teeth will not be unacceptable at the present time. My observations will commence with the results of German investigators, who, by their laborious researches and minute investigations, have done more than any nation to clear up the doubts and mysteries connected with the structure of the different parts of the human organism.

A paper, by Mr. Charters White, read some months back, raised a point of great scientific interest and practical value, and showed how divided was opinion as to the necessity or desirability of preserving intact the Dental pulp after some portion of its surface has been laid bare by decay of the tooth substance.

Two questions of importance are involved in this discussion—one as to the extent to which the pulp is essential to the vitality and well-being of the tooth, and another as to how far by its preservation it may be made to take up such healthy action as shall cause the deposition of bony substance with a view to its protection from external influences. With regard to the destruction of the pulp and the plugging of the pulp-cavity after its removal, opinions must always, I think, be divided, for not only are the results obtained wanting in uniformity, but the treatment must necessarily depend, to a large extent, upon the peculiarity of individual cases. When we come, however, to the question as to whether, apart from aiding vitality, it may take up a reparative action, we enter upon the discussion of a question which must be decided, for the most part, upon a knowledge of the structure of the pulp itself, and in this we may, having clearly ascertained certain facts, lay down sound and broad rules for action.

For years past a structure has been known and described as being developed in the pulp-cavity when the tooth and pulp have been subject to any external irritation. By Tomes it is called secondary dentine; by Owen, osteo-dentine; by Ulrich, osteoid; while by Hohl it is named odontome and osteo-dontome. Julius Brück, jun., following the classification of Hohl, divides these growths into pure dentine bodies and osteo-dentine bodies. By Garretson, in his "Diseases and Surgery of the Mouth, Jaws, and Associate Parts," they are also described as osteo-dentine; and this name is adopted by Harris in his work on Dental Surgery. From the observations of Tomes ("System of Dental Surgery") we have the deposition or development of secondary dentine given as a usual, but not constant result, of caries, or fracture of the tooth, or some other condition that has produced irritation of the pulp. The late Thomas Hulme, in a paper entitled "Contributions to Dental Pathology," mentions a case in which the pulp-cavity was entirely filled up by secondary deposit, as the result of irritation from a gold wire passing round the neck of the tooth to support a partial set of artificial teeth. In this case the laying down of new structure had evidently progressed, as the friction of the wire had gradually worn a groove into the tooth. A case is also mentioned in the same paper showing a like deposition of new matter in an incisor tooth, the lingual side of the crown having been worn down to such an extent as to show the outline of the pulp-cavity, quite visible from the difference in structure of the secondary growth. Numberless other cases are also on record of this reparative process in the Dental pulp of the human subject. German investigation has, however, shown that this osteo-dentine is far more frequently present than has been yet (I believe) accepted as a fact in this country.

According to the observations of Julius Brück, jun., contained in his "Histologie und Pathologie der Zahnpulpa," these secondary growths may be divided into pure dentinal bodies and osteo-dentinal bodies, and appear in the pulp as either round, branch-like, agglomerate, or made up of concentric layers, appearing under the microscope to be surrounded by a belt; both sorts are milk white, or, in a dry condition, yellow, or sometimes brown, with a certain transparency; seen alone by the naked eye, they appear smooth on the surface, but magnified, they are always discovered to be uneven, broken, or angular in outline. They vary in dimension, from immeasurable smallness to the size of a mustard-seed, or sometimes greater; in structure, they are entirely identical with that of normal dentine *(Zahnbein)*, with this difference, that the normal dentinal canals lie much closer together than the canals in these dentinal bodies. In the latter, their direction is from the periphery to the centre, taking a serpentine course, and are lost in the centre, while in the oblong-shaped bodies of dentine they run parallel to the long axis.

These secondary growths are found, not only in the permanent teeth, but also in perfectly healthy milk teeth.

Brück observes, that when at the period of the second dentition he has had occasion to extract thoroughly firm milk teeth on account of the smallness of the jaws, and before they have become absorbed at their roots, these bodies were constantly present: he found the same with a permanent canine tooth, which he extracted on account of its malposition in the Dental arch. His plan of observation was to saw through the tooth at the neck, and then remove the pulp with a nerve extractor.

In molars, canines, and incisors, he discovered these bodies in considerable numbers.

Ulrich, on the other hand, asserts that in single-fanged teeth he has seldom seen more than one, and in bicuspids and molars seldom more than two or three of such growths.

These new dentinal formations in the pulp are found, not only in man, but also in the lower animals.

In the mammalia, Brück found them in the teeth of the dog and horse, but not in those of the pig, calf, ox, or sheep.

This condition of the pulp is found most frequently (as Tomes has already shown) in teeth where the crown has been worn down by mastication, or in chronic cases of caries.

According to Wedl, there is an especial tendency in some individuals to the development of this new formation. This last observer states that during the period occupied by the changing of the teeth, hard formations may often be discovered in the milk teeth which have arrived at a "senile state."

These dentinal bodies may occur in any part of the pulp, and by their extension come into contact, and become fused together. The surrounding pulp texture may became ossified, and these growths then attain to the size of a small pea.

If in this way several such dentinal bodies join, the pulp-cavity—against the walls of which they lie—becomes smaller, and eventually closed.

When this new formation reached down towards the fang portion of the pulp, Brück found nearly the whole of the nerve canal filled up, and by this union of a number of these bodies a rod of secondary dentine was seen. In like manner, the crown portion of the pulp-cavity may become filled in with new formation, and this itself be attacked by caries. For the observations of these bodies, Brück recommends the plan suggested by Frey, which is, after having made a thin section, to fix on a cork with sealing-wax, and grind them down to the required degree of thickness on an emery stone.

The second sort of hard bodies occurring in the pulp-cavity are the osteo-dentine growths, which Brück has found only in the fang portions of the pulp.

The small bony bodies are seen lying in the centre, surrounded partly by dentine, partly scattered in the latter, and sometimes congregated together.

Brück believes that these have been mistaken for the chalk bodies by Wedl, in his "Atlas of the Pathology of the Teeth."

There is little question, as Brück observes, that these smaller dentine bodies which he mentions have been hitherto overlooked, and notice has only been taken of them when, by their fusion together, they have become sufficiently large to be seen with the naked eye.

A microscope of high magnifying power is essentially necessary in order to perceive the smallest of them, which are scarcely half the size of an ordinary cell, and present the appearance of a fine, small splinter, with a single canal.

As to the origin of these dentinal bodies, Wedl believes them to be developed by the dentine cells (odontoblasts) having suffered a kind of inversion from the periphery to the centre, and from these inverted dentine cells he makes the dentinal bodies in the centre form in the same way as the normal dentine. With this view Brück does not agree.

Hohl thinks, in his work "On the Formation of the Tooth Pulp," respecting the formation of the odontome, that the action is simply physiological, and is owing to an elementary change in the pulp texture modified at a later period. This, however, I think is enveloped in obscurity.

The position which the dentinal bodies occupy, indicate, apparently, the different sources of development: one the centre of the pulp, or perhaps, more likely, the lining membrane of the pulp-cavity. Brück says that if a fresh pulp be taken and hardened in alcohol or Müller's fluid, very fine transverse sections may be made, which will show, under the microscope, these dentinal bodies in various stages of development from the pulp-cells, and also from the investing membrane.

I believe it is impossible to over-estimate the importance of these investigations, as it plainly indicates a great change that must be adopted ultimately with regard to the treatment of exposed pulp. It is clear that if it can be satisfactorily shown that there is a continuous action going on in the pulp-tissue, either physiological or pathological, by means of which this sensitive tissue is converted into an ossified mass, that we have strong grounds for endeavouring to preserve this organ as far as possible in its integrity, in order that this process may not be suddenly arrested.

A tooth will, without doubt, be longest preserved for future use after it has once been attacked by caries, by restoring or maintaining it in a state as nearly as possible approaching the normal condition. In those instances, then, where we have extensive decay, softening of dentine over the pulp, and partial exposure of that organ, the wisest treatment will be that which prevents further exposure, inflammation, and suppuration of the pulp, and at the same time checks the progress of decay, and counteracts the results of the decomposition of the dead tissue. The following elements are necessary for the success of this process: the removal of softened dentine, except immediately over the pulp; the careful preservation of that organ from injury during the removal of softened tooth substance; and then the introduction of such materials as shall be thoroughly antiseptic, good non-conductors of heat and cold, and, at the same time, possessing caustic properties to such an extent as to destroy the superficial sensitiveness that may be present; or, if desirable, the pulp may be treated first alone before filling the cavity caused by decay.

If the latter be done, there are two things which, I think, we should bear steadily in mind; they are these—that whatever we use, the irritation should be reduced to the minimum, so that as little of the pulp-substance as possible may be destroyed, and only that portion of it which is diseased should be so acted upon as to be capable of removal afterwards. By this means we preserve, as far as can be done, the normal condition, a point which

I have already observed to be of the utmost value.

What substances are the best for this purpose when the pulp is treated alone, without plugging the tooth at the same time? I believe, as the result of experiments and continued experience, that Pepsine and dilute hydrochloric acid, or Lactic acid in place of the Pepsine, will be found to most nearly fulfil the conditions that we require.

By the use of either of them we dissolve out the dead animal tissue, the living structure not being acted upon if ordinary care is used. By this means we have the greatest chance of removing only that which it is undesirable to retain, while we lessen the risk of inflaming that which remains, and on which the vitality of the tooth so much depends. If, however, we deem it wise to put in a plug at once,—and on many occasions it is so,—then the oxychloride of zinc stoppings are undoubtedly the most useful: they are at once caustic, antiseptic, and good non-conductors, and experience has proved to most of us the extreme benefit to be derived from their use in all those cases where there is any indication of only a thin layer of softened dentine protecting the dental pulp.

After a year or eighteen months, if these stoppings are removed, we find a hard structure (probably, in fact, generally darkened in colour) in place of the soft tooth-tissue, and upon this we may put in a good gold plug with perfect safety. Perhaps the best test as to the amount of protection afforded by this hardened dentine, is to either wash or syringe the cavity out with cold water; in this way we detect at once any point of weakness that may remain.

After my previous observations on the dentinal bodies found in the pulp-cavity and the pulp-substance, it is only fair to surmise that this result is largely owing to their increased activity and development, and it is on this hypothesis that I would urge the conservation of the dental pulp in a larger number of cases.

It is certainly better that the pulp-cavity should be filled up by an organized tissue rather than by the most perfectly applied fang plugging, more especially when we find that such a manifest provision is made by nature to utilize this delicate organ, by developing within it a structure that shall at once protect it from external injury and maintain its intrinsic vitality.

Acute Pulpitis.

Inflammation of the pulp may arise under two distinct conditions, and it may be the result of one or other of several causes.

The first and commonest condition is when the tooth is carious and the pulp is exposed. The second, and comparatively rare condition, is when the pulp is surrounded by healthy bone structure, and there is no indication of caries in the tooth. As to the causes of acute pulpitis—first, it may be the result of irritation from foreign bodies lodged in a carious cavity, and coming into contact with the pulp substance, or it may be the effect of sudden and violent change of temperature, occurring under the same conditions as the last cause, or it may arise from a wound given in the course of excavating the decay from a tooth, when the Dental pulp is not exposed to direct external influence. Acute inflammation may be the result of a mechanical injury or shock to the tooth, or a general inflammatory condition of the body and disturbed arrangements of the secretions may induce it.

The pain occurs in paroxysms; it is increased by the patient occupying the recumbent position, from the increased blood supply, and when the inflammation has extended to the apex of the fang, the surrounding soft tissues become involved, and great pain is experienced on pressure. As the violence of the inflammatory action increases, so it spreads to the neighbouring teeth, and induces sympathetic pain in the opposite jaw. If, owing to some fortunate circumstances, such as the perfect localization of the cause of disease, or early and efficient treatment, the inflammation does not extend beyond the pulp-cavity, no pain will be felt on pressure, though probably sensitiveness will be manifested on percussion.

In this acute state of the disease the pain will seldom last more than three or four days, as the inflammation will have gone on to the stage of suppuration, and the destruction of the pulp will have been accomplished. In the course of a short time the tooth changes colour, loses the appearance of vitality, and if we examine the pulp cavity after extraction of the tooth, we find the nerve and blood-vessels, with the lining membrane, a fine, shrivelled-up body, in the form of a thread. When, however, the pulp-cavity has had free communication with a carious opening, this condition will not be so marked as in those cases in which the tooth structure surrounding the pulp has been perfect; and there is also this distinction to be made between the two —that if the inflammation be the result of a violent blow or constitutional condition of the body, the change of colour is more marked than in those cases in which the inflammation has resulted from a direct exposure and injury to pulp itself.

The cause of the malady will indicate the best means of allaying the symptoms that present themselves; under any and all circumstances, however, there can be no doubt that local depletion by leeches is beneficial.

Hypertrophy of the Pulp.

Under this title the Germans include that condition of the tooth-pulp which we know in England as dental polypus. All things considered, probably the German name is the best, as we have not only the polypoid excrescence through the pulp-canal into the carious cavity, but there is also an enlargement of the pulp in its fang portion, so much so that from the morbid conditions that accompany this growth, Mr. Tomes believes there is small chance of preservative treatment being successful—with regard to the pulp, that is. (Tomes's "Dental Surgery," p. 473.)

In structure, this excrescence consists of a spongy mass, made up of intercellular substance, and round and spindle-shaped cells, congested and readily bleeding, under pressure becoming painful and suppurating. The structure is given on the authority of Wedl.

The method of treatment recommended by Brück is extirpation with a bistoury, by means of the galvanic battery, with caustic, or by the actual cautery. If these fail, then compression by the aid of a temporary stopping. By this means the pulp substance is either removed or its death caused by the compression; but should they fail, Brück tries counter-irritation to allay the inflammation they may have induced, and, as a last resource, extraction, though great care must be used, on account of the walls of the pulp-cavity having been reduced in thickness by absorption.

Before extraction it is worth trying, however, an injection of Ferri Perchloridii.

Atrophy of the Pulp.

Under certain conditions the dental pulp wastes away, and in some instances entirely disappears.

To this form of disease the Germans have given the name of atrophy, and there can be little question that it well represents the state under consideration.

It has a predisposition to occur under certain local conditions which I shall presently mention, but it is also found, according to Brück, to prevail under different constitutional influences, and at various special periods of life. The local causes are long-standing cases of chronic periodontitis, when inflammatory action has been set up, and ultimately produced a blocking up of the blood-vessels, thus causing wasting by deficient nutrition, or when the inflammation has advanced so far as to set up suppuration, and thus induce atrophy by solution of the pulp substance. It is also found where periodontitis has advanced to the stage of perforation of the alveolar process, when the wasting away may be the result of the combined action of deficient nutrition and solution by purulent matter.

Amongst the constitutional causes may be noted diabetes, an anæmic state of body, old age, and those periods of existence which we recognize under the term "change of life." In all of these we see that influence which, acting locally, we know as deficient nutrition. And we may by a side light, as it were, see more clearly why it is that certain forms of toothache are relieved so much by good feeding, and a stimulating and nutritive course of medicinal agents, such, for instance, as the syrup of the phosphates of iron and lime.

There is one form of atrophy, the "net-like," in which the whole of the pulp substance is not lost, but the vessels are emptied of blood, and the nerve-fibres become shrunken and wasted. Under the microscope this gives the shrunken pulp a net-like appearance, but the cases, though interesting, are somewhat rare and difficult to demonstrate in a satisfactory manner.

The treatment of this class of disease has been already indicated; it must be to a large extent general, by means of tonics and stimulating drugs, and locally according to the prevailing symptoms.

Discoloration of the Teeth.

Discoloration of the teeth arises from a change which takes place in the contents of the dentinal tubuli. When arsenic has been applied for the purpose of destroying the pulp, the blood supply is cut off, and that peculiar change in the appearance of the tooth with which most of us are familiar occurs; the colour which takes the place of the natural tint is either red, blue-black, or ash-grey, depending upon the length of time that the tooth has been under the influence of the arsenic, and upon the density of the tooth substance. Extravasation of blood, caused by severe inflammation, will also produce a reddening of the dentine, which will show distinctly through the enamel.

Heyder, in "The German Quarterly Dental Journal," mentions the cases of two young girls aged 7, in which the same thing occurred in apparently healthy teeth: they assumed a pinkish shade, but were otherwise quite normal.

This tendency to red coloration of the teeth also occurs in cases of cholera, meningitis, and typhus, while the dirty yellow colour is most intimately connected with diseases affecting the abdominal viscera: in phthisis and chlorosis the teeth have a very white and transparent appearance. Chloride of lime, leeches, and citric acid, are recommended as remedial agents, though Brück prefers drilling into the pulp-cavity, destroying the nerve, and the introduction of liquor ferri sesquichloridii. A mode of treatment, lately suggested by Dr. Bogue, of the United States, is, however, I think, to be preferred.

Dental Caries.

Predisposing Causes.—Following the explanations volunteered by our patients, we are apt to confound predisposing conditions with immediate causes of this form of disease. The most frequent predisposing state is, I believe, a defective organization of the tooth. We have the honeycombed tooth, or the peculiar state associated with scrofula; or it may be intrinsically perfect constituents of a tooth but imperfect formation, as in the instance mentioned in Tomes's "Dental Surgery," p. 275, where decay arises from the dip in the centre of the crown, between the cusps of a lower molar, leaving a deep fissure invisible to the naked eye, with a thin plate of enamel, affording but a slight protection to the dentine below.

With the scrofulous form of tooth there is also associated an inflammatory and spongy state of the gums, in many cases passing on to a more severe stage, and thus giving rise to a muco-purulent discharge from around the necks of the teeth. This is, however, mainly found in the poorer classes, and those who suffer from imperfect nutrition and bad sanitary conditions.

I have not found an increased tendency to caries in the subjects of inherited syphilis, for, although the forms of the teeth are in many cases imperfect, abnormal, or dwarfed, the enamel is not necessarily of that low state of organisation associated with some other inherited diseases.

Or again, we may have a delicately formed constitution in which the entire organism is fragile and keenly susceptible to any influence of an injurious nature.

In this class we may find perfect forms and no structural defects; but the constituent elements are of such a character that they readily succumb to decay in the presence of an immediate and exciting cause. Of this I shall have to treat later.

Further, I would direct attention to a predisposing irritant that has not, I think, been sufficiently taken account of. I refer to the effect produced by constant and extreme alternation of temperature. This I deem one of the most potent agencies in civilized life in producing that condition of the teeth in which caries can manifest itself, and rapidly go on to their entire destruction.

It is hardly necessary to point out that this cause will operate far more in some persons than others, and that the delicately constituted teeth will be more susceptible of its influence. All this is selfevident. If we examine a piece of china, the enamel of which has been but imperfectly fused, we find, after it has been in constant use for some time, that it becomes marked all over with minute cracks, so fine and so thoroughly diffused that they seem not fissures, but have the appearance of a general change of colour on the surface of the article affected. Still closer examination will show that these cracks in the china enamel are most closely placed in that part which has been brought into contact with a similarly hard substance; as, for instance, in the case of a cup and saucer, where the cup stands, the saucer will be most distinctly marked. Now, making all possible allowance for the extreme difference between a piece of pottery and a living organism, I cannot but think we have a somewhat analogous process going on in the teeth, and predisposing caries. Certain it is that those who are most subject to extreme alternations of heat and cold are most subject to decay, and also that in those countries of extreme cold and high civilization caries is largely prevalent; as, for instance, in such cities as St. Petersburg, where sound teeth are quite the exception in all classes of the community.

Amongst ourselves, the bad state of the teeth in cooks and domestic servants is notorious. If negative evidence were of value on a point of this character it might easily be given; but for such a purpose I do not think it would be wise to accept it as of any practical use.

The frequent and careless administration of medicines containing mineral and vegetable acids also acts as a predisposing cause, though, unless by dissolving off a portion of the enamel, I do not see how they operate.

Drs. Leber and Rottenstein have produced most conclusive evidence of the effect of change of temperature on the teeth by alternately placing a tooth in water of the temperature of hot dishes as served at table, and then placing the same tooth immediately in ice-cold water. This has produced in a very short time that cracked surface on the enamel with which most of us are familiar.

Drs. Leber and Rottenstein, after discussing fully the predisposition to caries which teeth may possess in themselves, owing to either quantitative or qualitative defects, pass on to the consideration of the action of acids on those organs. They take it for granted that all are ready to accept the fact of acids acting on the enamel, and that the teeth cannot be acted upon solely by water; at the same time it is not necessary to employ very strong acids in order to produce a result, the carbonic and phosphoric acids easily separating from the lime with which they are combined.

In opposition to this, however, we must bear in mind one case, cited by Mr. Spence Bate, in which a lady found that a duplicate piece carrying natural teeth was kept in water constantly, and yet at the end of some years presented the same appearances of decay as those natural teeth which she had been wearing as an artificial denture.

Drs. Leber and Rottenstein believe that this is to be explained partly by the process which has been demonstrated by Wedl and Heider. These German pathologists noticed that some teeth which had been placed in pure water were at the end of ten days attacked by a species of fungus, and a few weeks were sufficient to alter the structures so much as to present the appearance of complete perforations of the enamel.

In the year 1843 Mr. A. Westcott, in connexion with Mr. Dalrymple, performed a series of experiments in America with a view to determine the action of acids on the teeth, obtaining the following results: — All mineral and vegetable acids act promptly on the teeth, also those salts whose acids have a greater affinity for lime than for their base; vegetable substances in a state of fermentation, and animal substances only operating when in an advanced state of putridity.

Mr. Allport obtained identical results. M. Mantegazza followed out the same experiments, and with like effects.

M. Magitot, in his work, published in Paris, 1866, entitled, "Études et Expériences sur la Saliva considérée comme Agent de la Carie Dentaire," affirms not only that acids and acid salts act upon the teeth, but that acids are the sole agents in the production of caries; the phenomenon of destruction of the dental tissues by those chemical agents being identical with those of caries.

The substances employed by this gentleman in making his experiments were solutions of a large number of acids, some acid salts, besides solutions of albumen, common salt, and alum.

For two years teeth were submitted to the action of these substances; at the end of this time the acid solutions had become neutral, and the teeth more or less softened and destroyed. In a great number of cases the enamel presented a chalky appearance. The dentine was brownish or yellowish, deprived of its calcareous salts, softened, and altogether having the appearance of carious tooth substance.

There are, then, according to M. Magitot—

1. Some substances which attack with equal force all the tissues of the teeth: to these belong, varieties of Sugar, but only in a state of acid fermentation; Lactic Acid, Butyric Acid, Citric Acid, Malic Acid, Carbonic Acid, the products of decomposition, and albuminoid matter.

2. Those substances which have the peculiar property of acting only on the enamel: Alum, Oxalic Acid, and their acid salts.

3. Substances which act exclusively on the dentine and cementum: namely, Acetic Acid, Tartaric Acid and their acid salts, and Tannin.

Drs. Leber and Rottenstein, in commenting on these experiments, point out, however, that there is the liability of their not showing clearly results obtained by the means employed, as the action of the agents used would be modified by the influence of the new products obtained; so that the acid reaction can scarcely be said to maintain itself after that period, when it shall have become neutralized by calcareous salts; they, therefore, believe that some of the phenomena obtained are caused by other agencies, such as the decomposition which takes place in the organic substance of the tooth, the putridity, fermentation, and the action of vegetable growths and germs, which may become developed in the course of two years.

In fact, M. Magitot seems to admit that towards the latter part of the time during which his experiments extended, the acids had become neutralized, and, as such, ceased to exercise any action whatever.

From the experiments of Drs. Leber and Rottenstein I obtain the following facts, showing the specific action of certain acids upon the teeth, and the manner in which they create a predisposition to caries:—

Tartaric Acid.—At the end of fifteen days the enamel was covered with very fine crystals, had lost its natural brilliancy, and presented an earthy-white appearance. The fang was slightly softened on its surface.

The Acid of Grapes.—After forty-four hours the enamel was very rough, and both it and the root were covered with numerous crystals; and at the end of fifteen days, the enamel being divided, presented an earthy-white and porous condition, the root not being further acted upon.

Acetic Acid.—At the end of ten days the anterior surface of the enamel of the crown was softened, and presented an earthy-white appearance, the posterior surface of the crown of the tooth not being acted upon; the root being easily cut at the surface by a knife.

At the end of seventeen days the entire enamel was acted upon, and the subjacent dentine decalcified; the root being readily divided with a cutting instrument.

Oxalic Acid caused a deposit at the end of seven days of crystals of oxalate of lime; the enamel, of an earthy-white, was raised easily with the nail, part of the surface of the crown retaining its polish. No alteration took place in the root. At the end of fourteen days the enamel was everywhere of an earthy-white, and the root was slightly acted upon.

Alum.—At the end of fourteen days the enamel could be easily raised with the nail, and the root more easily cut than in the normal state.

Lactic Acid produced, after seventeen days, a milky-white appearance on the enamel, with slight loss of polish; the fang was also softened to some extent.

In conclusion, these authors state that their results agree with those of Mr. Westcott, Mr. Allport, and M. Mantegazza, who found that all the vegetable acids, without distinction, act upon the enamel of the teeth.

Sugar, pure and simple, does not seem to exercise any prejudicial effects; it is only when it is changed in character by fermentation in the cavities of the teeth, and between the inter-dental spaces, that mischief ensues, and disintegration of the enamel follows.

The action of fungi in producing or accelerating caries is a matter that I must leave for the present.

In the conclusions which have been drawn from the experiments to which I have called attention, there seems this point of weakness, that the action produced by acids on the teeth is a *cause* of caries. I do not think that, either practically or theoretically, this is the cause, and hence the remark with which I commenced this section of my Notes, that "we are apt to confound predisposing conditions with immediate causes."

I dwell upon this point, because I believe it involves the question as to the best mode of treating caries of the teeth; the experience of many, accurately collected and carefully compared, will, I believe, show that it is impossible to assign any single process or action as the cause of decay in the dental organs. When we remember that the mouth is the chamber through which passes all the nutrition of the body—solid, fluid, and gaseous—and that it is liable to be acted upon by all the various conditions and temperatures in which the several forms of nutrition may be taken in, there seems fair ground for coming to the conclusion that all these, severally or in combination, may produce that condition which we know in the teeth as caries. I would not shut out, as predisposing states, mechanical pressure and irritation going on to such an extent as to cause disintegration of the tooth-substance; but I would not have them confounded with the immediate cause of decay.

Looking at the facts that are constantly being brought under the practitioner's notice of cases where the patient tells us that up to the time of some illness or other there was no decay of the teeth, it seems inevitable that we must look for the cause of caries within, and not without, the tooth.

I have shown in the earlier pages of these Notes the effects of certain forms of disease in producing marked changes in the appearance of otherwise normal and healthy teeth. Is it not reasonable to suppose that in all cases of caries an organic change of the tooth itself takes place, forming the first stage of decay? May we not go further, and say that in many instances we can assign the cause as a want of balance between the organic and inorganic constituents of the tooth, and that in others it is the general impaired nutrition of a local, or, it may be, a result of character?

If it can be clearly shown that the actual and immediate cause of caries in the teeth is from within, then we have more certain data for going upon in the treatment of this form of disease.

If the morbid change is due to influence received from the general system, then it is plainly indicated that the treatment must be, to some extent, general as well as local; in short, that it is no use filling up a cavity in a tooth while the state of the system that induces decay is left unacted upon by any remedial agents.

All of us have seen those cases where patients coming home from India bring sickly children, asking what can be done to increase the strength of the fragile and delicate-looking teeth, and we are aware to what an extent these conditions are improved by diets and medicaments containing the salts of lime.

We thus see that we can act upon the teeth through the system, and if for one condition, why not for another?

I have strayed away from the subject proper of my Notes; but these remarks seemed to follow as a natural sequence.

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